APPENDIX A

State Inspection Programs

ADOT - Arizona

ADOT is working to tie "levels of service," or LOS, explicitly to maintenance budgeting. Development of a LOS-based budgeting procedure will require some changes in how data on the maintained condition of highway features are collected and reported.

The length of highway covered in each annual survey will be reduced by using a sampling approach. Sample sections will be 0.5-mile long. The samples are randomly generated each year using the Maintenance Budgeting Program (MBS).

In the new approach, LOS will be expressed as letter grades – A, B, C, D and F. Plus-and-minus grades may also be used if finer gradations are needed. The updated data collection procedures will support these graded LOS values.

All field inspections of maintained features will take place in highway "sample sections" that are each 0.5-mile long. A total of a few hundred sample sections will be inspected each year, based on statistical design as well as resources available for conducting the survey. These samples will provide an indication of the total network condition statewide. Samples will be selected in each route under the responsibility of a roadway org – this will ensure that highways of different functional classes and geographic locations are sampled each year. The location of the sample section will be selected randomly each year – this ensures diversity in the sample set and avoids bias due to unique conditions that may exist at particular locations.

- The length of the sample section is 0.5 mile. The width of the sample section extends from right-of-way line to right-of-way line. [(C) And (D) in the sample section on the following page.] Only features that are within this sample area and are maintained by ADOT should be inspected.
- The sample area will contain the mainline highway lanes and shoulders (A), a frontage road if present (B), adjacent right-of-way, and a median in the case of divided highways. The survey will cover features on all these components within the survey area. Quantities of features will be summed across these components if needed (e.g., pavement surface area will include the sum of the paved areas of all roadway lanes and paved shoulders on all roads).

- If the section includes an intersection, inspect all ADOT maintained features within the mainline right-of-way except traffic signal equipment (E) and Bridge Decks.
- Interchange ramps (F), acceleration and deceleration lanes, truck lanes, and turning lanes should be included in the survey. When counting the lanes in the survey section, all of these features should be included as a lane. The sample segment has 7 lanes – 4 mainline lanes, 2 frontage road lanes, and 1 ramp. If at either end of ramp there are multiple lanes, count all lanes. If there is a partial lane and there is 2 tenths of a mile or more count it as a lane.

ADOT Roadway Maintenance Survey Form

Date: _____ Inspector: _____ Phone: _____

Org Number: _____ Route: _____ Beginning Milepost: _____ # of Lanes: _____

Condition Indicator	N/A	Ratings				
PAVEMENTS AND SHOULDERS						
Asphalt: ☐ Mainline ☐ Frontage ☐ Ramp		Check the box at the left, which describes the portion of the roadway that is being measured.				
1. Asphalt: number of unfilled potholes--all lanes		If < 20, enter count: _____		If 20 or more, simply check box at right		☐
2. Percent asphalt surface with open cracks.		*Make sure; a), b), & c) are noted below*				
a) Alligator cracking		0-5%	5-10%	10-30%	30-50%	>50%
b) Other cracking, up to ¼" wide		0-5%	5-10%	10-30%	30-50%	>50%
c) Other cracking, greater than ¼" wide		0-5%	5-10%	10-30%	30-50%	>50%
3. Percent asphalt surface with bleeding		0-5%	5-10%	10-30%	30-50%	>50%
4. Percent asphalt surface with raveling		0-5%	5-10%	10-30%	30-50%	>50%
PCCP: ☐ Mainline ☐ Frontage ☐ Ramp		Check the box at the left, which describes the portion of the roadway that is being measured.				
5. PCCP: number of spalls and faulted or settled joints—all lanes. (Bridge Decks **NOT** Included)		If < 20, enter count:		If 20 or more, simply check box at right		☐
6. Unpaved shoulder: Overall condition of Maintained unpaved shoulder from edge of pavement.		Excellent	V. Good	Good	Fair	Poor
7. Unpaved shoulder: Percent length with erosion or edge drop-off > 2"		0-5%	5-10%	10-30%	30-50%	>50%
ROADSIDE, SAFETY AND DRAINAGE						
8. Percent length of guardrail with broken or bent rails; broken or bent posts; severe corrosion; or loose or broken bolts		0-5%	5-10%	10-15%	15-25%	>25%
9. Are any guardrail or barrier end treatments missing or damaged?		No			Yes	
10. Do any crash attenuator elements needing repair?		No			Yes	
11. Is sweeping of roadway pavement needed? (Phoenix and Tucson ONLY)		No			Yes	
12. Litter		No litter	Few pieces	Small patches	Unsightly areas	> half the area
13. Percent of fence panels missing or damaged		0-5%	5-10%	10-30%	30-50%	>50%
14. Percent length of lined channels with debris or vegetation. (3 sided concrete lined channel)		0-5%	5-10%	10-30%	30-50%	>50%
15. Percent length of unpaved ditches with rock or mud slides, debris, or vegetation. (This includes overhead crown ditches) Gunite lined ditch		0-5%	5-10%	10-30%	30-50%	>50%
16. Pipe openings, down drains, other drainage features silted to >25% depth		0-5%	5-10%	10-30%	30-50%	>50%

Manual contains image examples of good and damaged criteria.

CALTRANS

The basic method used to develop data for the LOS2000 Review was the application of randomly generated values that match the desired percentage of one-mile highway segments. The total state highway inventory was divided into one-mile segments (some segments may be less than one mile, but are greater than 0.5 mile) and random samples were selected within each District using the random number function in the LOS2000 automated program. Each District's segments were sorted by random number and the first 12 percent were selected (70 segments for District 12). The first 10 percent of randomly selected segments were evaluated (18% for District 12), with the remainder serving as substitute segments. Table 1 reports the number of segments and centerline miles sampled in each district, and the percentage of each district's total centerline miles that were evaluated.

Table 1

District	Number of Segments Evaluated and Percentage of Total Number of Segments in District (if less than 100%)				
	Roadway	Landscape	Roadside Rest Areas	Vista Points	Park & Ride Lots
1	100 (10%)	39	7	16	6
2	182 (11%)	21 (88%)	19	10	10
3	145 (10%)	52 (49%)	12	10	26
4	144 (10%)	50 (10%)	3	10	44 (98%)
5	140 (12%)	53 (98%)	5	7	9 (90%)
6	177 (10%)	49 (74%)	5 (71%)	3	11
7	113 (10%)	54 (12%)	2	1	47
8	188 (10%)	51 (35%)	13 (87%)	4	14
9	102 (10%)	2	5	17	1
10	132 (10%)	36 (73%)	2 (33%)	23	5
11	99 (10%)	50 (28%)	7	5 (83%)	38
12	50 (18%)	50 (44%)	NA	NA	2 (67%)
Total	**1,572**	**507**	**80**	**106**	**213**

District personnel consisting of the LOS2000 Coordinator and at least one Caltrans Maintenance Supervisor or above administered the field survey. Other District and Headquarters personnel, including District Liaisons, were also invited to participate in the review. The Quality Assurance teams evaluated 10% of the randomly selected segment samples in each district.

Florida

- Rate all sample points from right-of-way to right-of-way, with the exception of rest areas, weight stations, service plazas, welcome centers, and inspection stations.
- If the sample point falls within the gore limits of a rest area, weight station, inspection station, etc. project the right-of-way limits across the ramp and rate for normal maintenance criteria.
- Rate only those items maintained by the district being evaluated.
- A sample is 1/10 mile or 528 feet in length.

Kansas

- 0.1 length samples
- 3360 random samples statewide
  - 112 subareas, 26 areas, 6 districts

Kentucky

Use statistical sampling techniques – random samples

0.1 mile section

After determining the beginning mile point location and the direction in which the section runs, the team will make sure there is not a bridge or other structure, an intersection, or a construction zone within the segment.

Louisiana

Field Sample Segments

Statistical methods will be used to identify randomly selected data sample sites along state highways. The sites are 0.10-mile segments (528 feet) selected in the 16,698 miles of roads (interstate and non-interstate) maintained by LADOTD. For non-interstate, divided highways, both directions of travel will be included in the sample. For Interstate routes, each direction of travel will be considered and sampled as a separate roadway. For a sample size that will give 95 percent confidence that the level-of-service average rating will be within 7 percent of the true value if the pass/fail rate is 80 percent for Interstate and 70 percent for non-Interstate, then the required sample size is 2,423 samples.

A random number table will be used to generate random numbers to select sample sites. Then roads within a district can be assumed to be a single road. For example, non-Interstate roads in District 2 can be assumed to be a single 1071-mile road. The required number of samples will be obtained (163) from the random number tables with values between 0.0 and 1.0. By multiplying these numbers by the total number of miles in each district, the mileposts of the field sample segments will be obtained. For convenience, the roads in each district should be arrayed in numerical order, with each road length noted.

All identified features within each field sample segment will be evaluated. The survey is intended to assess the current condition that exists at the point in time when the evaluation takes place. In the future, two or more surveys per year should be conducted to account for seasonal variations.

Maryland

The Maryland Condition Assessment Reporting System (MCARS) is designed to provide SHA managers with an accurate, reliable evaluation of the condition of SHA's highways and roadsides, and the level of service we are providing our customers. It is critical we maintain our managers' confidence in the accuracy of the data collected in this program.

The MCARS Program will employ teams, composed of three people, reviewing highways maintained by each of SHA's 28 shops. The three person teams will be drawn from a pool of 11 people, four from the Office of Maintenance (OOM) and seven from the districts. Using a limited pool of evaluators helps bring consistency to the program. OOM will designate three of its four participants as MCARS Team Leaders who will lead the three person teams. The fourth OOM participant will serve as an Alternate Team Leader and as a participant on teams.

MCARS Program data collection will occur in the months of June, July, and August. MCARS personnel will spend a minimum of two days evaluating highways in each shop's area of responsibility. In addition, the reviews will be done, when possible, during two different months. The intent is to minimize the effect of weather on a shop's review. In addition, two different teams will evaluate each shop. The intent is to increase the number of people reviewing each shop which will lessen the subjectivity of the review. The teams will evaluate approximately 30% of each shop's centerline miles, ranging from 57 to 213 one-half mile sites. Roadways in remote areas will not be omitted.

The team will review 21 maintenance elements, down from 29 elements in the previous years. The desired maintenance condition or level of service for some of the elements changed as well. The teams will evaluate elements in four major categories:

1. Shoulder
2. Drainage
3. Traffic Control and Safety
4. Roadside

Michigan

All MDOT roadways are divided into 1/10 mile sections and numbered. From these numbered sections, test sites are selected using a random number generator. GPS coordinates are then matched to the beginning point of each selected site. Maps of the selected test sites will be supplied to the evaluating team with test site information including test site number and longitude and latitude coordinates.

Missouri

The size of our system and impracticality of evaluating each mile of roadway necessitates the selection of a statistically valid sample of one-tenth mile segments for each functional roadway class for field inspection. Roadway features within the sample segments are then field inspected using the performance indicators as a basis to determine a LOS expressed as a number between 1 and 100. Individual segment ratings are then averaged to determine LOS ratings. Approximately 1,500 segment inspections stratified by functional class will provide a valid sample for the entire system's LOS, and potentially valid information as to each district's LOS.

Mississippi

The MDOT State Highway System consists of approximately 13,052 miles of roadway. A complete field inventory and condition assessment on a system of this magnitude is not possible within the time constraints of the MMS project. To the extent possible, inventory and condition data will be obtained from office records. The field data collection will be done on a sampling basis, using randomly selected 0.1-mile sample sites. Each feature to be collected is described in detail in Appendix A. A sampling methodology has been established to provide statistically valid results at the 95 percent confidence level with 7 percent precision.

Approach

The current condition, or level of service (LOS), of the various road assets maintained by the MDOT will be estimated using a statistical approach. The usual practice is to collect data on random samples, using 0.1-mile sample sections. A sufficient number of 0.1-mile sample

sections will be selected to provide statistically significant data at the district level and by road classification (Interstate, U.S. and Other).

For each District and road class, the number of road miles was used to determine the number of samples required for roads and the number of bridges was used. It was assumed that Interstate and U.S. roads are divided, requiring separate samples for each direction of travel. The rest of the roads were assumed to be undivided.

Sample Size Formula

The following equation may be used to determine the minimum sample size necessary to achieve the desired confidence and precision for LOS measures:

$$n = \frac{(z^2)(p)(1-p)}{e^2 + \frac{(z^2)(p)(1-p)}{N}}$$

where:

n = Sample size (for example, number of 0.1-mile increments).

N = Population size (for example, total number of 0.1-mile increments).

z = Standard normal deviate (that is, number of standard deviations for desired level of confidence).

p = Proportion of the population that meets a specified criteria (for example, pass/fail – expressed as a decimal value from 0.0 to 1.0).

1 - p = Remaining proportion of the population.

e = Allowable sampling error (or precision), expressed as a decimal.

Values of *z* for Frequently Used Levels of Confidence

Confidence Percentage	z
68.3	1.000
90.0	1.645
95.0	1.960
95.5	2.000

Confidence Percentage	z
98.0	2.326
99.7	3.000

For condition assessments, a confidence level of 95 percent is generally considered sufficient ($z = 1.96$). The value for p was assumed to be 80% for Interstate and U.S. highways and 70% and for Other highways. To keep the number of samples at an achievable level for the study time frame and, at the same time, achieve an acceptable level of precision, +/- 7 percent was selected ($e = 0.07$). After some initial data collection in the Districts, the value of p can be reviewed and "fine-tuned", if necessary, but these values have worked well other states.

Sample Sizes

The inventory of roads maintained by MDOT was obtained from the Pavement Management System. For each District and class of road, the number of miles was used to determine the number of samples required as shown in Exhibit B-2. It was assumed that Interstate and U.S. highways are divided, requiring separate samples for each direction of travel since there are two separate roadway cross-sections. The rest of the roads were assumed to be undivided, i.e., only one roadway cross-section.

Table 2 - Number of Samples Required

(For 95% Confidence, +/- 7% Precision)

District	Highway Class	Centerline Miles	Samples by Class	Total Samples by District	Crew-Days Required [1]
1	Interstate	0	0	288	24
	U.S.	967	125		
	Other	1,612	163		
2	Interstate	261	123	411	35
	U.S.	650	125		
	Other	1,596	163		
3	Interstate	200	122	409	34

District	Highway Class	Centerline Miles	Samples by Class	Total Samples by District	Crew-Days Required [1]
	U.S.	624	125		
	Other	932	162		
5	Interstate	572	125	412	35
	U.S.	480	124		
	Other	1,425	163		
6	Interstate	528	124	412	35
	U.S.	858	125		
	Other	1,268	163		
7	Interstate	118	120	408	34
	U.S.	651	125		
	Other	1,110	163		
Total		13,852		2,340	198

North Carolina

A statistical sample of 0.1 mile segments.

Ohio

The Maintenance Quality Survey (MQS) is a visual inspection conducted from a moving vehicle, of the eight maintenance categories. The MQS Inspection vehicle speed ranges from one mile per hour to a maximum of 20 miles per hour. Two teams consisting of two inspectors, inspect one quarter of every county's state maintained highways every three months. The MQS teams use laptop touch-screen computers with GPS technology to collect the maintenance deficiency data.

South Carolina

The Maintenance Assessment Program (MAP) was developed in response to a need for an objective method of analyzing and measuring the performance of the South Carolina Department of Transportation's (SCDOT) maintenance division. One goal of the program was to determine the level of service that is being provided to South Carolina's motorists. This would also allow a calculation of the amount of improvement that would be required to obtain a higher level of service, and the associated cost of the improvement.

Another benefit of this program is that a consistent expectation of performance has been established for the entire state. Areas that need improvement have been identified and available resources can be directed to these areas. In some cases, improvement plans and programs have been developed in an effort to improve the performance.

The MAP was modeled after a similar program that the North Carolina Department of Transportation was utilizing. The MAP is a random statistical analysis of the South Carolina Department of Transportation (SCDOT) maintenance performance on the primary and secondary highway system throughout the state. Key elements of maintenance were identified for evaluation. Significant indicators were chosen in each of the seven key elements that would be evaluated. Two-tenth mile sections of roadway are randomly selected throughout the state. A two-person inspection team physically inspects these elements on the randomly selected segments of roadway. The inspections are scheduled throughout the year to ensure that they are performed in all seasons. This is done to alleviate any seasonal variances in the key elements inspected.

The seven elements that were evaluated are: (1) Pavement, (2) Shoulders / Ditches, (3) Drainage Structures, (4) Roadside, (5) Signs, (6) Pavement Markings, and (7) Guardrail. Each element is evaluated and the condition is recorded in a database. The elements and their condition indicators are located in Table 1. An evaluation of the maintenance of the state's interstate system and bridge system were not included in the MAP. The bridge maintenance division has a separate program for evaluating the condition and needs of the state's bridges. The interstate system was not included because of the concern for the safety of the raters and motorists, and the ensuing traffic congestion. Therefore, all maintenance needs and funding identified in this report excludes the needs for our interstate and bridge systems.

For both primary and secondary highway systems, a statistical sampling was made to determine the location of sites to be surveyed. Approximately 1,443 sites were randomly selected statewide for inspection. This equates to approximately 1% of the total inventory. During the period between January 2006 and December 2007, survey teams assessed the condition of these 0.2-mile sections. The inventory of each element and the quantity of the deficient conditions were recorded and summarized, and a maintenance condition rating calculated. From this assessment,

the necessary maintenance activities to achieve the various levels of service were determined along with their estimated costs.

The data collected has been used to objectively determine the current level of service provided by the maintenance division. This information permits a projection of the amount of work necessary to bring the entire state's maintenance service to a desirable level. A cost can be associated with this work to assist in identifying funding needs. The program also points out the substandard areas to local SCDOT departments. This information is used to assist with planning and the allocation of existing maintenance resources.

Tennessee

The Maintenance Rating Program will provide a portion of the condition assessment for Roadway assets. This will be in the form of what is referred to as the Maintenance Rating Index, or MRI. The MRI is a numerical score on a 100 point scale, 100 being a perfect score. This score is generated from surveys that are performed each month, by District personnel, to determine the present condition of each roadway segment. The roadway segments measure 0.1 mile and are randomly selected each month. Surveys are conducted on all types of state highway facilities. The type of maintenance required for each roadway segment determines the classification of a particular facility. The current Facility Type classifications are:

1. Interstates
2. State Routes
3. Other (not currently used, but reserved for future use)

Each Facility Type classification is divided into 5 Elements:

1. Traveled Pavement
2. Shoulder
3. Roadside
4. Drainage
5. Traffic Services

Each of the 5 Element listed above are further subdivided into many Characteristics. For example, the Roadside Element is composed of the following Characteristics:

Grass Height
Landscaping / Wildflowers
Litter Pickup
Access Control Fence

Roadway Sweeping
Graffiti
Vegetation / Brush Removal
Slopes / Erosion Control

Inspection consists of 0.10 mile segments that are randomly selected.

Texas

Texas Maintenance Assessment Program (TxMAP). TxMAP consists of:

- 1 mile segments randomly selected
- In FY 2007 over 4000 one mile sections were evaluated from the inventory of 79,897 roadway miles.

Virginia

Randomly selected 0.10 mile segments.

Washington

1. Statistical methods are used to identify approximately 2,200 randomly selected data survey sites around the state. These are 0.10 mile sections (528 feet) selected from the approximately 7,000 centerline miles of state highway inventory.
2. Using Milepost Markers and the vehicles DMI, locate and mark the start and end points for each site. Mark the points with paint at the edge of the shoulder so that they can be located again if needed.
3. If any portion of the site falls on a structure, the site should be moved forward or backward as necessary to avoid the structure.
4. Sites in construction zones should not be evaluated. Relocate the site outside of the construction area but as close to the original site as possible.
5. Activate flashing lights on vehicle, place cones for safety, and use appropriate traffic control measures. Always wear required safety equipment, reflective vest, supportive footwear, etc.
6. Conduct field measurements and observations at the sites and record the data. When performing data collection always try to walk facing traffic. On divided highways and freeways it may be necessary to drive around to the lanes in the opposite direction and set points on that side of the road as well. Remember SAFETY FIRST.

Wyoming

1. For each collection team, a list of statistically valid, randomly selected roadway segments to be assessed shall be provided to each district, by Headquarters Maintenance Staff.
2. On segments with Interchange ramps or other such lanes, **"DO"** include these when gathering data within the selected segment.
    a. For example if you have an interchange within the selected segment, you would gather all data from the interstate to where the ramp(s) meet the connecting mainline or at the point in line with the selected segment end(s). The same would hold true for such lanes as a free right turn.
3. Should any portion of an approach, culvert, cattle guard be inside the marked segment, it will be counted and the entire item evaluated.
4. The team shall include one team leader that is assigned by the district maintenance engineer, to assure consistent data collection. A collection team of four (4) persons and two (2) vehicles seems to work efficiently, usually completing a segment in about 30 minutes. It should be noted that the size of team can vary, depending on availability of resources during data collecting. Simply put, it can be performed with two (2) persons and one (1) vehicle; it just may take a bit longer.
5. Using the Nearest Increasing reference marker, along with a distance measuring instrument (DMI) or a vehicle's trip odometer, segments shall be located and the beginning and ending points marked with spray paint.
    a. Marking the ends with spray paint will help the validation collection to assure that both teams *(Maintenance Staff and District)* are assessing the exact same area.[1]
    b. A segment equals .20 tenths of a mile or 1,056 feet in length.
    c. A DMI should be checked periodically for proper calibration.

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[1]Be sure to also mark segment ends on interchange ramps and other added lanes.